

ESTABLISHMENT OF *CYBOCEPHALUS* SP. (COLEOPTERA: NITIDULIDAE)  
FROM KOREA ON *UNASPIS EUONYMI* (HOMOPTERA: DIASPIDIDAE)  
IN THE EASTERN UNITED STATES

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*Abstract.*—In 1983, a species of *Cybocephalus*, tentatively identified as *C. prob. nipponicus* Endrody-Younga, was imported from the Republic of Korea and released on euonymus trees and shrubs infested with the euonymus scale, *Unaspis euonymi* (Comstock). The predaceous nitidulid is well established at three release sites in the metropolitan Washington, D.C. area and has reduced the scale populations on the host plants. Distribution is in progress to establish this beneficial beetle at other locations in the eastern United States.

*Key Words:* Biological control; armored scales; predator; Diaspididae; Nitidulidae.

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In 1980 the Agricultural Research Service, United States Department of Agriculture, initiated a Small Farm Research project to study the biological control of several species of armored scale pests. Among the targeted insects was the euonymous scale, *Unaspis euonymi* (Comstock), an exotic pest of Asian origin that is devastating to many species of ornamental plants of the genus *Euonymus* (Gill et al. 1982).

Because *U. euonymi* is common in Korea, the USDA Asian Parasite Laboratory, Seoul, Republic of Korea (ROK), was assigned the task of obtaining natural enemies of the scale as a part of its research effort. Among the many biotic agents found was a species of *Cybocephalus* that preyed on all stages of the euonymus scale. We have tentatively identified this nitidulid as *C. prob. nipponicus* Endrody-Younga through comparison with paratypes of *C. nipponicus* in the collection of the United States National Museum of Natural History, Washington, D.C.

Species of *Cybocephalus* are important predators of diaspine scales. They may rank second to the Coccinellidae as predators of armored scales but nitidulids and their impact on scale populations have received relatively little study. However, several species have been introduced into various parts of the world for scale control (Drea 1988). Limited introductions of *Cybocephalus* spp. have been made into North America but with little success. A species of Japanese origin, referred to as *C. probably gibbulus* Erichson, was introduced and established in California in 1932-1933 for the control of the California red scale, *Aonidiella aurantii* (Maskell), (Rosen and DeBach 1978). Although the predator expanded its host range to include two other species of scale, it has not proven to be effective (Bumgardner 1945). In 1956-1957, a *Cybocephalus* sp. from India was introduced into California but did not become established (Rosen and DeBach 1978).

Our introductions of *C. prob. nipponicus* began in 1984. Three sites were selected in the metropolitan Washington area for releases of the beetle. On April 5, 1984, a total of 29 adults (24 ♀, 5 ♂), from Namhansan-song, Kyeonggi Province and Seoul, ROK, were released at the Chadwick Overlook at the National Arboretum on *Euonymus fortunei* (Turcz.) Hand.-Mazz., a shrub heavily infested with *U. euonymi*. A colony was established and living individuals were regularly collected at this site through 1986.

A second site in the National Arboretum was a grove of euonymus trees near the Administrative Center. In August, 1984, 15 adults (11 ♀, 4 ♂) from Sacheon, Kyeong-sangnam Province, ROK, were released on *E. europaeus* L. heavily infested with the euonymus scale. Within several weeks the colony expanded and the beetles spread to neighboring euonymus trees, *E. hamiltonianus* var. *nikoensis* (Nakai) Blakelock and *E. kiautshovicus* Loes., also heavily infested with the scale. The scale population on the release tree had been reduced to an insignificant level by late summer, 1986, and the tree has shown increased growth.

The third release site was an unidentified euonymus tree at the USDA Beltsville Agricultural Research Center in Maryland. In May, 1984, a total of 32 adults (25 ♀, 7 ♂) were released on the tree and quickly increased in number. Individuals were recovered from the tree in 1985 and 1986.

Because a laboratory colony of the beetle was not established, it was necessary to utilize field collected insects for the releases. However, before any beetles were released, samples from the Korean material were dissected and examined for parasites, but none were found. Furthermore, Williams et al. (1984) report that there are no known parasites of adult *Cybocephalus*, although larvae of the genus are recorded as hosts of *Zeteticontus* (Encyrtidae), *Aphanogmus* (Ceraphronidae), and *Zatropis* (Pteromalidae).

Once a field colony was established, no

additional releases were made with Korean specimens. Consequently, a total of 76 adults (60 ♀, 16 ♂) were liberated in the three sites of the metropolitan Washington area. Using the trees in the National Arboretum as a natural insectary, more than 4000 *Cybocephalus* adults were collected and shipped during 1985 and 1986 for release by co-operators in Pennsylvania, New Jersey, Delaware, North Carolina, and Ohio.

Blumberg and Swirski (1982) present a comprehensive study of the biologies of *C. micans* Reitter and *C. nigriceps nigriceps* (Sahlberg) that prey on diaspine scales in Israel. Our observations suggest that *C. prob. nipponicus* has a life cycle similar to these two nitidulid species.

At the National Arboretum the beetles had 3, and possibly 4, generations per year. The greyish-white eggs,  $0.5 \times 0.2$  mm, were laid in or under empty scale coverings and in other protected areas. According to Blumberg and Swirski (1982), eggs of the species they studied hatched in about one week, and the larvae completed 3 instars in one or more weeks. Pupation reportedly occurs on the plant, in debris near or on the plant, or in the soil (Clausen 1956, Kartman 1946). Pupae of *C. prob. nipponicus* were found on leaves of the plant.

Adults of *C. prob. nipponicus* are small, about 1.0 mm in length, hemispherical in appearance. The female is entirely black, the male has a yellow head and pronotum. The adults can live 1 month or more depending upon the season. Overwintering beetles at the Arboretum survived at least 5 months, from November to April. During the winter beetles were active on the trees when the temperature was about 10°C.

There appears to be a degree of host specificity in species of *Cybocephalus*. Blumberg and Swirski (1974) noted a difference in the effect of the species of scale on the development of the species of *Cybocephalus*. They observed that *C. micans* preyed mainly on the nymphal stages of *A. aurantii* and other diaspine scales and that younger instars of

the predator were not able to feed on mature female scales. Our laboratory and field observations with *C. prob. nipponicus* indicated that the small male scales are the chief prey of the adults. More beetles were found on leaves infested with the males of *U. euonymi* than on branches where the female scales were more abundant. Microscopic examination indicated that more male than female scales were damaged by the beetles.

The sex ratio, was 1:1 determined from 756 individuals of 7 field samples, collected from May through September, 1986.

At present, *C. prob. nipponicus* is well established at 3 sites in the metropolitan Washington area. The beetle has had an impact on the populations of euonymus scales at these sites. The predator has increased to a level that has permitted the collection and shipment of the beetle to other states in the eastern United States. However, the population of the host at the original release sites has been reduced to a very low level, because of the predation by *C. prob. nipponicus* and by a coccinellid, *Chilocorus kuwanae* (Silvestri), also introduced from Korea and established at the same study sites (Drea and Carlson 1987).

#### ACKNOWLEDGMENTS

We wish to thank Ho-Yeon Han and Jang-Hoon Lee, personnel of the Asian Parasite Laboratory, who assisted in the original collections in the ROK; S. G. March, U.S. National Arboretum, Washington, D.C. for assistance in locating scale populations; and L. R. Ertle and R. M. Hendrickson, Jr., Ben-

eficial Insects Research Laboratory, Agricultural Research Service, USDA, Newark, Delaware for assistance in quarantine clearance and release of the beetle in northern areas.

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